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THE
PANAMA CANAL
AND THE
DAUGHTERS OF DANAUS

BY

JOHN BIGELOW

1908

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AND THE
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JOHN BIGELOW

Rusticus expectat dum defluat amnis: ut ille
Labitur, et labetur in omne volubilis ævum.
Epistolæ Horatii I. 2. 43.

He who defers the hour of reform, like the
fabled rustic, waits for a river to run dry
that rolls on forever.

SECOND EDITION
REVISED AND CORRECTED

NEW YORK
THE BAKER & TAYLOR CO.
1908

Roosevelt 351.4 B482 p2

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PREFACE TO THE SECOND EDITION

While the first edition of this pamphlet was in the printer's hands, the announcement was made of Colonel Goethals' intention to suppress the dams recommended by the President on the Pacific side, and with them the so-called Sosa Lake. As the technical reasons were fully ten times more weighty for the suppression of the Gatun dam and lake, I seem to have allowed the reader to infer that the suppression of the one was merely a prelude to a corresponding suppression of the far more reprehensible Gatun earth dam on the Atlantic side, which the President himself pronounced "risky." In this I was mistaken, for it now appears that Colonel Goethals proposes to prosecute that work, though so many times more unstable and insecure than the ones Major Goethals rejected for their unstability and insecurity on the Pacific side of the Isthmus. I jumped too hastily to the conclusion that the Gatun dam in due time would share the fate of the other. This error will be found corrected on pp. 36, 37, 38. I leave it to Colonel Goethals to reconcile a principle of construction which is true on the Pacific side of the Isthmus but false on the Atlantic side, conditions being similar.

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THE PANAMA CANAL AND THE DAUGHTERS OF DANAUS

BEFORE the present Federal Congress separates, about four years will have elapsed since the property of the French Panama Canal Company became the property of the United States. The prosecution of that work was then confided by the President, nominally at least, to the War Department. The present time seems, therefore, opportune for a consideration of the progress of this imperial enterprise and to cast our horoscope for the year if not the day when the world will be invited to assist at the nuptials of the Atlantic and Pacific oceans.

On the twentieth of August last, Lieutenant-Colonel Goethals, the present Chief Engineer of the canal, wired the Secretary of War that, "The works scheduled for the fiscal year ending June 30, 1908, can be finished three months earlier—that is, by the thirtieth of next March"; but for that purpose recommends that an emergency appropriation be asked from Congress in time to avert any cessation of construction. The amount of this emergency appropriation, as announced by the Panama Canal Commissioners, is $8,000,000. On the twenty-seventh of August, the Acting Secretary of War wires Mr. Goethals that the President approves of his "creating a deficit" in the manner proposed.

As this document of Colonel Goethals is likely to occupy not a little of the serious attention of Congress, it is given here at length as printed in the "Canal Record," an official periodical issued weekly "under the authority and supervision of the Isthmian Canal Commission."

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Secretary of War, CULEBRA, Aug. 18, 1907.
Washington:

Construction work for this fiscal year is developing faster than was contemplated. Report of expenditures for July shows we are exceeding monthly allowance for labor and have already obligated, very largely, appropriation for material. Results are being obtained in proportion to increased expenditure and with lower unit cost. With present organization and programme, Canal can be completed more rapidly than by keeping within appropriations now available. As compared with last year's appropriation for construction, we have one million dollars less for labor, and the same for material, notwithstanding largely increased demands due to the necessity of starting new work on the Chagres Division, and relocation on the Panama Railroad for which no allowances were made. Work on locks and dams on each terminus has been opened up and should be pushed vigorously this year. Very little was expended at these points last year. *Time of completion of Canal now appears to depend on work at Gatun, progress at Gatun dam dependent on removal of present railroad track to new location. In order to lay concrete in locks next year, plant must be contracted for this year,* but appropriation not sufficient. If in accordance with Revised Statutes 3679, request *authority to continue expenditures in excess of pro rata monthly allowance on account of present necessities and unforeseen developments* since estimates were submitted, with understanding that Congress will be requested to make additional appropriation to cover the deficiency at next session. Additional funds required for construction this fiscal year, four millions for labor and four millions for material; total, eight millions. This is required, not as an increase of cost of Canal, but in order to work faster. If not approved, request to be informed as soon as possible so that work can be reduced and expenditure kept within present appropriations.

GOETHALS.

I

WE now know that at the end of June next, 1908, there will have been expended on the Panama Canal by *our* government	$ 79,608,568.58
As the President has authorized a subordinate in the War Department to approve of the emergency appropriation, it is already being spent whether constitutional or not—	8,000,000.00
which gives a total of expenses to the close of the current fiscal year of	$ 87,608,568.58

The total cost of the lock canal with a summit level at eighty-five feet above the sea, as estimated by the Isthmian Canal Commission in its report of 16th November, 1901, was to be	$144,233,358.00
Deducting from this the generous sum specially allowed for engineering, police, sanitation and other contingencies, of	24,038,893.00
there would remain for expenditures on the canal proper	$120,194,465.00

The same commission in their report of 1901 decided that the canal they proposed could and ought to be finished in ten years, the two years consumed in preparations inclusive.

The canal which was advised by the minority of the consulting board assembled in Washington in 1905 by the President, and which the President recommended, is also a lock canal, with a summit level at eighty-five feet above the sea. It differs from the canal of 1901, on the plans of which the construction was begun in May, 1904, by a different location of the dams and locks.

It has been stated that the time and cost of construction would remain practically the same for both forms of canal. It has been also stated that all the works made prior to the modification of plans were also useful for the new plans and that no time nor money would be lost by this modification. Therefore we are entitled to depend on the original figures relating to cost and time in order to judge the results actually obtained.

Four years plus two months will have elapsed on the thirtieth of next June. On the Isthmian Canal Commission's estimates the following will be the proportion of expenditures that should have been incurred and work done for the completion of the canal within the promised period of ten years:

As the expenses for sanitation, engineering, police, etc., must largely be made in proportion to the time lapsed, four tenths of $24,088,893, say $9,600,000, ought to have been spent on that account next June.

This would leave at that date a total expenditure of $78,000,000 for the works alone.

This sum represents exactly six and a half tenths of the total sum of $120,000,000 provided for the works.

Colonel Goethals asserted in his telegram that his request for more funds did not mean an increase of cost of the canal above the estimates. He must, therefore, be prepared to show to Congress that at the end of June next:

First. Six and a half tenths of the Gatun dam across the valley of the Chagres River, or 5000 feet of its length of 7700 feet—in other words considerably more than half—had then been built.

Second. That nearly four of the six huge twin locks to be provided should then also be complete and ready for ships and commerce.

Third. That of the remaining 54,000,000 of cubic yards of excavation left by the French Company to be made, 35,000,000 cubic yards should have been excavated by our engineers.

We will now turn to the "Canal Record" to ascertain what portion of this work has been done or will be done two months after the expiration of the fourth year of our management of it.

First. Of the six and a half tenths of the Gatun dam to be built, thus far not a load of stone or a shovelful of dirt has been contributed to it. It is of this work that Mr. Goethals said in his reported application for an emergency appropriation just quoted, that "the time of the completion of the canal now appears to depend on the work at Gatun, not on the excavation of the canal."

Hitherto the Culebra cut and the control of the Chagres have been the lions in the path of this canal. This rashly projected dam is now for the first time presented as a terror more formidable than either of the others, and the work of subjugating it is not yet begun. We learn by the "Record" of September 18th that "*it is hoped to start* the construction dam before the first of January."

Second. Four of the six huge twin locks required should be nearly ready for use within less than half a year, according to the money spent. Yet not a block of stone has been cut for one of them. According to the "Record" of September 4th, "It is believed that the actual masonry work can be commenced at the Gatun locks within eighteen months"—that is, the first stone may possibly be laid in March, 1909. So recently as the twentieth of October last, the Canal Commission submitted to the Secretary of the Navy the question of widening the locks, so that it is doubtful if even the plan and dimensions of the locks can be settled before February, 1909.

Third. Of the 54,000,000 cubic yards of excavation in the Culebra hill, upon which most money has been spent and the Government's force ought to have been concentrated as exclusively as practicable from the beginning, at least 35,000,000 should have been removed in June, 1908. Of this, however, but 7,812,186 cubic yards had been removed at the end of June last. It is now apparent that there will not have been extracted on the thirtieth of June next, according to the average yearly output, but at the most about 17,000,000 cubic yards; barely one half of the output which the money expended requires. Even this small output has been obtained for the most part in simply widening, without deepening the cut as left by the French Company. Indeed, the public has no evidence that the cut has been deepened an inch. When Colonel Goethals begins to deepen the cut he cannot expect to maintain even his present moderate output, except at a prodigious increase of expense, for every foot the trench is deepened, the greater the risk of slides and the accumulated volume of torrential rains which unsettle the roadbed almost as fast as the rails can be replaced.

At the pace of expenditure during the present fiscal year of $34,000,000, following an expenditure of $26,000,000 last year, it would not be safe to reckon upon an expenditure of less than $40,000,000 a year in future; which means that by the autumn of 1909, or say scarcely a year and a half from the thirty-first of June next, 1908, the total sum which the Panama Canal was estimated by the President's engineers to cost, will have been expended, and certainly less than one third of the projected work completed.

II

It deserves to be remarked that the expenses incurred on this canal have not been swollen, as in the case of a private corporation, by brokers' fees, by interest on capital, by costs of advertising or commissions of any kind; that it was not confronted at the beginning, as the De Lesseps Company was, by a virgin forest. On the contrary, the whole line of the canal was studded with workshops, dwellings, much costly material, roads of access and service, not to speak of an enormous collection of technical documents of great value. Besides, it was equipped with the prophylactics with which modern science has armed the canal-diggers, since the beginning of this century, against the malignant fevers with which the French Company had constantly to contend; yet, with all these advantages, physical and financial, enjoyed by us, we are forced to the humiliating admission that the De Lesseps Company, the life of which terminated so disastrously for its stockholders, spent considerably less money for the work accomplished than we have done. During the eight years of their control of the canal, from the third of March, 1881, to December, 1888, their average annual expenditure for the work done was twenty millions of dollars to execute seventy-two million cubic yards of excavation in seven years and nine months. Our Government between the moment it came into the possession of the French property and March last, have spent an annual average of sixteen millions of dollars to execute in two years and eleven months only six million cubic yards of excavation—a difference which shows that the French Company on an average had about four times more return of work for the money spent than our Government had in that time.

President Roosevelt, in his Message of December, 1906, and shortly after his return from his naval promenade to Panama, stated: "The French excavating machines, though of excellent construction, are mere toys when compared with the new steam shovels, just as their wagons for removing the excavation resemble the toys of children when compared to the long trains of platform cars which empty themselves that we employ." He adds: "In the season of rains our steam shovels cannot do much in the movable earth, but they work constantly in the rock or in the hard ground."

The President could apply to the enormous cars what he says of the steam shovels, and add, that in excavating the movable earth they would regularly be off the rails instead of on them. If the French Panama Company had as recklessly measured the weight of its locomotives and cars by the greatness of the cut, regardless of the ground and the rains, by adopting the American machinery which first took its place, it would not have done anything during nine months of every year. The President himself admits that these machines do nothing in movable earth during rains. Most of the trenches at the time of the French occupation were of soft clay, while the Americans' work of to-day has been for the larger part in hard clay and rock.

The President evidently did not take sufficient account of these facts or he would have hesitated to compare to toys the mechanical system which, twenty years ago, excavated, with half the number of men than are now employed, in the three last years of the old Company's existence 1,400,000 cubic yards a month, while the so-called superior American machinery now employed, at a quadruple expense, had given as a maximum up to the time of the President's message but a cube of 325,000 cubic yards per month, or less than one third of the cube officially announced in April previous by the President of the Isthmian Canal Commission as the expected monthly excavation of the second half of 1906—1,000,000 cubic yards.

In the three days the President spent on the Isthmus he was naturally too much occupied with the festivities awaiting him to inform himself that there were at that very time one hundred French locomotives *toying* in the canal, while only thirty-nine American ones were "making the dirt fly"; that there were also at the same time 541 French dump-cars toying for the children of the Zone, and but 324 genuine dirt-flying American dump-cars.

Had his Excellency, when crossing from Colon to Panama, felt as much interest in the subject as he exhibited a few weeks later in his Message to Congress, and consulted the Superintendent, he might have learned that there were at that very time exactly as many French as American locomotives—twenty-four—operating the railway on which he was riding.

While on this subject, it may be well to call the reader's attention to the recent resurrection of "a French elevator dredge which had been lying," according to the official "Canal Record," in the Rio Grande above La Boca for more than twenty years, and for $20,000 "has been restored in every part so that it is now capable of excavating 120,000 cubic yards of material per month, an amount equivalent to that removed by four ninety-five-ton, five-yard steam shovels. This dredge," the "Record" adds, "when in service at the La Boca entrance of the canal will do more work than a modern dipper-dredge costing $102,500. . . . The engine which had remained in the jungle near Sam Pablo for more than twenty years was in excellent condition and could not be surpassed by modern machinery, both as to adjustment and economy of operation. The copper piping on all the machinery is of very heavy design and shows much more careful workmanship than is found in modern machinery. The remarkable preservation of this machinery was due in the first place *to the high quality of the material used* in construction, and in the second place to the use of white lead and grease which excluded the air.''

Referring to this dredge, in the ''Record'' of October 9th, it says:

> ''Her performance is even more satisfactory than was anticipated. The engines and transmission machinery run smoothly, the control is simple and effective, and the consumption of coal economical for the power developed. . . . Owing to the long haul, the mud barges working with the dredge *are unable to dispose of all the material that could be removed by this machine.* Arrangements are being made to add new barges to the fleet. *One French barge has been re-built and the work of overhauling another has begun.* When this shall have been done, the output of the dredge will be considerably increased.
>
> ''Another old French dredge of similar type is now being repaired in the Crystobal dry dock, and will probably go into commission about the last of October.''

We have been waiting nearly four years to discover that twenty-six years ago the French employed dredging machines superior to those we have provided. Now we see, if we consult the recent report of the Isthmian Canal Commission for 1906–1907, what our dipper-dredges have proved their capacity for doing.

On page 50 we find that:

> ''The new five-yard dipper-dredge, similar to those ordered for the Colon dredging division, was accepted, and commenced operation at noon, May 20, 1907, in the channel in the vicinity of the wharf [La Boca]. From May 20 to June 30 it was operated twenty-two working days, during which time it excavated 22,300 cubic yards of material.''

In the same space of time one old despised French dredge would have excavated 150,000 cubic yards, say about six times what our so-called ''modern dredge'' could do.

So recently as the twenty-fifth of December the ''Canal Record'' reports, "Work was continued on ten old French locomotives and fifty old French dump-cars in order to put them in condition for service."

And yet more recently, on the first of January, the "Record" tells us that "The Sanitary Department has recently called the attention of the Chief Engineer to two seventy-five-ton coal-barges lying in the Rio Grande where they had been *abandoned.* These barges are in fairly good condition and can be economically rebuilt. It is thought it will not be a difficult matter to float them out during high water in the river.

"Because of the special design of these old French barges they have the same advantages as ships built with a double bottom, and are structurally very strong and practically unsinkable. The space between the bottom of the barge and the bottom of the hold, with the lateral bulkheads, forms airtight compartments, so that if a hole were knocked in the hull by a collision, or even if the hull itself were cut in two, the barge would float. This feature of construction has proved its usefulness on several occasions."

The ignorance of our engineers about dredging soft ground is still darker when the question of dredging hard ground comes.

The September excavation of 1907, reports Mr. Goethals, was the largest which had then ever been made—1,481,297 cubic yards. Unfortunately, of this output 403,852 were dredged in Colon and 144,625 in Panama—in all 548,477, not in the Culebra but in the low and marshy levels of the coasts, and, like so much of the two previous months, may, part or all, have to be handled again for the construction of the dams, or be wasted, leaving the Culebra output for this month but 763,286 cubic yards.

Could the whole of the output be credited to the Culebra, it would still be ridiculous to treat the result as a triumph over the old French Company, as the organ of the Canal Commission persists in doing. The latter achieved their average monthly output of 1,400,000 during 1886–1887 and 1888, with but 15,000 operatives; we, for a feebler average, with practically little if any yellow or Chagres fever to war upon, with sea-going suction-dredges propelled by twin screws costing without their equipment over $362,000 apiece, had about 40,000 men on our payroll.

It may here be remarked parenthetically that the Ancon, which is the name of the first of these powerful and costly dredges, has been employed ever since its arrival at the canal entrance in Limon Bay, not in the Culebra cut, and when loaded, steams out to sea to discharge its cargo off Toro Point. The others by this time are doing the same kind of inopportune and wasteful work.

It will be many years—six at least—by the rate it has been progressing, before the bottom prism of the canal will be cut to the level of forty feet above the sea in the Culebra in order to obtain a water level at eighty-five feet. I apprehend it will be no easy matter for those who ordered this expenditure of $1,086,000 for suction-dredges to explain to the satisfaction of Congress why they were ordered so soon, or when ordered they were set to work when and where it was impossible to utilize their output. Of course, the policy of protecting our infant industries requires that no money should lie in the Treasury long enough to prompt the plain people to ask whether some of their taxes might not be lightened by a reduction of the tariff; but that not being one of the policies for which the Washington Government stands at present, are there not plenty of other uses for our accumulating millions, from which the country some day might derive some advantage?

If, as the scientists say, dirt is matter out of place, then these costly machines are in a dirty business, the more dirty because the only other apparent motive than the one just referred to for dredging Limon Bay at this time is to swell the amount of output and mislead Congress and the public about the value of what is really being done at the Isthmus.

The only excuse I have for dwelling thus long upon the comparative achievements of the French and the American canal-diggers on the Isthmus is that, from the very inception of the work by our Government, it has manifested a fear that there would not be glory enough to go round if any credit whatever was conceded for what, during their many years' occupation, the French engineers had done toward proving the practicability of piercing the Cordilleras by an oceanic channel.

It will be hard to persuade any person who knows Colonel Goethals that either he, or any officer of his rank in the American army, would, of their own motion, have diverted men and machines from the work where most required merely for the ignominious purposes of imposing upon and obscuring the judgment of the legislative branch of the Government. No one knows better than they also that it is no part of the business of a Government commission to vaunt the superiority of its engineers over any others, foreign or domestic, even when they shall have demonstrated the fact, which this Commission has not yet done, nor shown any likelihood of doing. Nor is it their business to cook canal statistics in a way to disguise either their lack of skill or their extravagance, but to build the canal as expeditiously and inexpensively as possible—precisely that and nothing but that. This nation is building a canal to facilitate the commerce of the world and to multiply its industrial resources, not that we may taunt the French for not accomplishing twenty years ago what they failed to accomplish only for lack of the Government support to which it was justly entitled, while our Government at that very time was making efforts for another Isthmian Canal which, but for the Herculean efforts of a French engineer, would have proved infinitely more disastrous to us than the French Company's collapse proved to them. What that Company had actually done for a canal we thought worth to us, and gave $50,000,000, in addition to the proof which they and they only could furnish, that the Panama route was the only practicable trans-continental canal route. Nor must we ever forget that but for a French engineer's superior judgment and active interference, we would have now been embarked upon another canal enterprise upon which we would have spent hundreds of millions before discovering that it was stillborn and could never be trusted to take on its bosom a ship or a steamer.

And now my readers, if any are so patient as to have followed me thus far through this dreary Serbonian bog, may be provoked to ask if we are to despair of having a trans-continental canal, or are we to be bankrupted in digging it? To these questions I answer that I do not despair of our having a stable, ample, and permanent canal, but not in this generation, if even in the next, unless prosecuted by other methods than those recommended by the President and by which it has been and is still operated.

I must here be indulged with some reminiscences which will explain, and I hope may excuse my meddling publicly with problems the solution of which are usually and properly supposed to belong exclusively to professional engineers.

III

In the month of February, 1886, in response to an invitation addressed by the late Count Ferdinand de Lesseps, the projector and the President of the Panama Canal, to the Chambers of Commerce of the maritime world to meet him at the Isthmus and inspect the progress of the great enterprise he was then prosecuting there, I accepted an invitation from the New York Chamber of Commerce to act as its representative on that occasion. I had been upon the Isthmus but two or three days before I realized the necessity of asking President de Lesseps if he could not put me into communication with some officer to whom I might with propriety apply for such information about the works as I required, without troubling him. The Count was no longer a young man; like myself he was not an engineer nor of course familiar with the details about which I was seeking light. "Certainly," he replied, "I will present to you the best man for your purpose that we have. He knows more about the canal work than any one else on the Isthmus." Presently, and obviously at his behest, a young gentleman approached and was presented to me. In presenting him the Count said to him with some emphasis, "Mr. Bunau-Varilla, you will please give Mr. Bigelow all the information he asks of you about the canal, without any reservations whatever," or words to that effect. The following morning I submitted to this gentleman, with whose name the world is now familiar, a series of questions which I had prepared on my voyage from New York, remarking at the same time that it would be a better economy of his time as of mine, for him to take the questions and underwrite his answers during his moments of leisure, than for us to sit down together to the work; for I saw that he was a very busy man, though I did not then dream, what I afterward learned, that he was only twenty-six years of age, and at the time was not only Engineer in Chief of the whole work, with from ten to fifteen thousand men under his command, but had the exclusive charge of the forty or fifty delegates who were to be slept, fed, transported about the Isthmus, and individually enlightened in regard to a complex system of works of which few of them could boast, more than myself, of having even an elementary knowledge. I did not then, nor until some three months later, learn Mr. Bunau-Varilla's age or official position and importance. Shortly after the guests of Count de

Lesseps left the Isthmus, Mr. Bunau-Varilla had been stricken with the country fever, a by no means surprising result of the accumulated cares that had been heaped upon him, in addition to those belonging strictly to his official position, and after narrowly escaping with his life he took a sick leave and returned to France for a change of air, nursing, and rest, calling upon me in New York on his way, his place as Chief Engineer being filled by Mr. Boyer.[1]

My acquaintance with Mr. Bunau-Varilla, thus renewed in New York, it has been a great pleasure I think to both of us ever since to cultivate; and I have thereby been qualified to give some particulars about his antecedent as well as subsequent life which is likely to make his name as enduring in American history as that of any other man of foreign birth.

Born in Paris in July, 1859, he graduated as Engineer of the *Corps des Ponts et Chaussées* in 1883; was detailed by the French Government as Engineer *des Ponts et Chaussées* in Tunis and Tripoli from May to September, 1883; again at Bayeux in France from September, 1883, to October, 1884. He was then sent by the Panama Company as Engineer in Chief of one of the three divisions on the Panama Canal from October, 1884, to April, 1885, taking, at this time, command of two of the three divisions of the canal, and in September, 1885, after the departure of Mr. Dingler, the Engineer in Chief of the canal, he was selected, as the fittest man then in the service of the Company, as his successor.

During his absence on sick leave the contractors for the excavations in the Culebra cut failed. As this cut was regarded and still is quite the most serious physical obstacle the Canal Company had to contend with, Mr. Bunau-Varilla, on his return to Panama, was requested to form a new company especially to prosecute that work.

Though the effect of this change was to separate Mr. Bunau-Varilla from the staff in September, 1886, he cheerfully accepted it. Before a year elapsed in his new position the difficulties he encountered from the torrential rains at the Isthmus in getting rid of his excavation by rail were so serious and costly that he became satisfied that some new method must be devised. Taking a hint from the greater cheapness of transportation by water than by land, well known to engineers, he began some experiments in artificial pools or lakes with dredges and tugs. He at length satisfied himself that excavation by a floating dredge, to be towed by a tug where its contents could be discharged promptly and at little expense automatically, would put an end to many of the difficulties to which the previous contractors had succumbed; that there would be no further need of the army of workmen to be constantly changing the rails as the excavation progressed, nor of workmen to watch and adjust the track, which could be neither firmly placed nor properly ballasted to long endure the use required of them. By this device he apprehended no further serious difficulties in contending with the frequent tropical deluges which cover and bury the rails with the detritus washed in from the walls of the trench; no more of the incessant derailings of cars which the incurable conditions of the soil and climate make inevitable, blocking often for weeks all communication between the points of loading and of discharge, leaving hundreds, if not thousands of men unprofitably idle or employed in repairing wreckage.

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[1] Mr. Bunau-Varilla's immediate predecessor as Chief Engineer, Mr. Dingler, had himself resigned and returned to France, broken-hearted by the loss of his wife and all his children from the malignant fevers of the country. Bunau-Varilla's successor died of the same disease in the month of April of the same year.

While thus experimenting with floating dredges, though still in a small way but encouraged by its success, he conceived the idea in 1887 of a temporary high level lock canal to be later dug by dredges floating on the water supplied by the Chagres River.

His plans were adopted and executed from the beginning of 1888. The financial collapse of the Company however, at the end of 1888, terminated his connection with the work. Had he been permitted to continue in charge of the work, he had counted confidently upon having the first navigable level across the Culebra cut established at the 170-foot level, and to thus open the canal for traffic in 1891.

IV

When, during Mr. McKinley's administration, our Congress seemed determined to pledge the credit of our Government in favor of an Isthmian Canal through Nicaragua, a bill for that purpose having passed the Senate both in January, 1895, and

1898, with only few opposing votes, and with no opposition from the Executive, some prominent gentlemen from Ohio met Mr. Bunau-Varilla by chance at a lunch in Paris at the time of the Exposition, and this disposition of the Washington Government became naturally a topic of conversation. As naturally it led to Mr. Bunau-Varilla's exposure of the folly we were in danger of committing. The merits of every imaginable canalizable pass in Central America had been more exhaustively studied by Mr. Bunau-Varilla for the De Lesseps Company than it had ever been studied before or since, and he had published a book in 1892 on the Panama and Nicaragua canals.

But a few months after this conversation, Mr. Bunau-Varilla received a note from one of the guests at the Paris symposium asking him if he would not come over and address a body of leading engineers and business men, who would be invited to meet him, on the subject of the relative merits of the Nicaragua and Panama routes for a trans-continental canal. Mr. Bunau-Varilla promptly notified the writer of his acceptance of the invitation. In less than a month, in January, 1901, he was heard in Cincinnati by a select audience, invited by the Commercial Club of that city. He was the same evening invited to address an audience, composed exclusively of engineers, on the same subject, at Cincinnati, and then at Cleveland, at the request of intimate friends of Senator Hanna. Subsequently, with brief intermissions, he responded to similar invitations from Philadelphia, Boston, Chicago, and, finally, from the Chamber of Commerce of New York. One of the results of these conferences was that at the following session of Congress the Nicaragua route was almost unanimously abandoned by both houses, for the Panama as the most desirable route. As a consequence of this change of public sentiment in Washington, the Colombian Government coöperated with Mr. Hay most zealously, and directed its diplomatic representative at Washington to negotiate a treaty to that effect, which was formally signed by the official representatives of the two governments.

When it became known at Bogota, however, that we were willing and had actually agreed to pay $40,000,000 for the property of the French Company, whose charter had but one year more to run, if a debatable prorogation of six years was not enforced, the Colombian Government refused to ratify the treaty. The object of this strange behavior, avowed by members of the Colombian legislature, was to await the expiration of the French charter, refuse to adhere to the prorogation, then confiscate the whole property of the French Company on the Isthmus, and appropriate the $40,000,000, or perhaps a larger sum, if a larger could be extorted, to their own use. Our Government, so long at least as John Hay was Secretary of State, could be a party to no such iniquity; neither were the people of Panama willing to risk the possible and even probable adoption of the Nicaragua alternative, which had many allies with large pecuniary interests staked upon its adoption. The result was the determination of the people of Panama to sever their political connection with the State of Colombia, and, following our example of 1776, proclaim their independence.

Having been kept by Colombia always impoverished to the last degree, and finding themselves unable to organize any effective defence of their independence if contested, for want of means to pay for weapons and soldiers and ammunition, a committee of three or four of the leading citizens of Panama—one of them the first and present President of the State of Panama—then repaired to the United States, where they had, of course, the best right to expect it, for financial aid. Of course they sought Mr. Bunau-Varilla, who chanced to be then in New York, and with whose previous history in Panama they were familiar and whose service to the canal they appreciated. Knowing full well the aggravating nature of their grievances, he lent them, without hesitation, $100,000, which he placed to their credit with the banking house of J. P. Morgan & Co. of New York. With that equipment fund the Panamanians were able to put themselves so far in a defensive position that the Colombian Government did not think it prudent to attempt seriously to disturb it. They realized that they had imitated the foolish dog which lost the beef in his mouth in trying to secure what he supposed to be another piece reflected in the water he was crossing.

The people of the United States have always thought it a fine thing, and one which every American minister on being accredited to the Government of France is accustomed to refer to in laudatory terms, that Louis XVI lent us a few millions to maintain our independence in 1776. But King Louis lent his people's money, not his own. Mr. Bunau-Varilla lent his own money and at a far more serious risk.

Under any dynastic government in Europe the conduct of Colombia in refusing to confirm a treaty which she had successfully used every means available in diplomacy to induce a friendly Government to sign, would have been regarded as an ample justification for an appeal to the last argument of kings.

We were thus and still remain indebted to Mr. Bunau-Varilla, not only for rescuing us from the disastrous folly of attempting a waterway through Nicaragua, and for the independence of the State of Panama, but for what is more immediately and specially important to us, for drawing with his own pen the treaty known to history as the Hay-Bunau-Varilla Treaty, which secured to us privileges of incalculable importance for the prosecution of our great national and international enterprise of which the State of Panama is to be the theatre; privileges the value of which at some future day will be more fully realized than they are at present.

V

The Hay-Bunau-Varilla Treaty with the new Republic of Panama was signed in November, 1903, and ratified February, 1904. The Isthmian Canal Commission, of which Admiral Walker was the first President, was recast and converted into an Executive Committee of Construction, and men ranking as eminent engineers were selected from different States for this Commission. Mr. Wallace was sent to Panama as Chief Engineer. Scarcely a year elapsed however before this Commission was dissolved, their efficiency as canal-diggers having failed to commend itself to the President or to themselves. An entirely new Commission was appointed, and Mr. Shonts, the president of a western railroad, was placed at its head, Mr. Wallace remaining Chief Engineer and becoming a member of the Commission. This was in April, 1905.

In the course of two or three months, Mr. Wallace, failing to accomplish what he had thought easy, resigned, and was publicly abused as a coward by the Secretary of War. Mr. Shonts then recommended the importation of Chinese workmen, and that failing as contrary to law, he recommended the letting out the digging of the canal to contractors, but upon terms which made illusory all advantages of the contract system. Both his recommendations failing, and the cube of the output in Culebra remaining one third of what he had publicly announced it was to be, he followed Wallace's example at the risk of being similarly stigmatized by Secretary Taft as a coward, and he also resigned. This was in January, 1907. Mr. Stevens, the Chief Engineer under Mr. Shonts, was then appointed to succeed him as President of the Commission. A month had scarcely elapsed before he braved the risk his predecessors had successively incurred, and resigned. It then became necessary for Secretary Taft to find a man who could not resign. He had tried the Navy, but Walker was a retired officer who could only be punished by calling him names. So he took an engineer officer from the Army who could not resign without greater personal sacrifices than army officers can ordinarily afford to make, especially when the code of honor does not require a cabinet minister to accept a challenge from a subaltern.

During these three years none of the several executive officers tarried scarcely long enough at their post to become informed of the number of men they had under pay and where they were severally at work. Of course the function of the Canal Commission seemed smothered in surmise; to be pursuing policies which kept the Government at Washington constantly on the defensive, "continually picking slivers out of their own shins."

Sensible of and deploring the President's embarrassment, Mr. Bunau-Varilla addressed him two letters setting forth what he deemed the errors which his engineers had been making from the outset, and by adherence to which he apprehended that the canal would not be opened for traffic in less than twenty years if a sea level canal was contemplated (as the President had in mind in the beginning of 1905), nor for three times the money which his engineers had estimated it would cost. In these letters he also explained how the canal might have been opened for traffic in four years and at a cost inferior to the original estimates of the canal at eighty-five-foot summit level. These letters were dated: the first, twenty-sixth of September, 1905, and the second, the twenty-ninth of October, 1906.[1] These letters cannot be too carefully conned by those who are officially responsible for the millions that are now being spent under what is obviously a pernicious system.

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[1] These letters we find at length in a brochure recently published in Paris by M. Bunau-Varilla entitled *Le Détroit de Panama—Documents relatifs à la Solution Parfaite de Probleme de Panama.* Dunod et Pinat, Publishers. The pertinent passages of both these letters will be found in Appendix A and Appendix B.

The vital features of what the distinguished French engineer terms the perfect solution of the Panama problem were:—

First. By dredging the contemplated prism of the canal instead of excavating it.

Second. To this end building on each side four locks for reaching the summit through the Culebra cut, the level of the water being not lower than one hundred and thirty feet above the sea.

Third. Constructing two dams, one at Gamboa of steel concrete, and one at Bohio of earth, but very low and narrow. Both these dams are across the Chagres on the Atlantic side of the Isthmus. With these dams to collect sufficient water, not only to navigate the canal but by its power to supply all the electrical energy required for lighting, for driving all the machinery, for dredging and for transporting the excavation, thus making an alliance with natural forces instead of contending with them. All the hard labor to be done practically, after the construction of the first high level lock canal, by electricity, of which the Chagres would furnish an inexhaustible abundance, while the officers and men conducting the dredges, scows, and tugs would be sheltered both from the rain and the sun, exposure to which are the chief perils of the Isthmian climate.

Fourth. No railway track, cars, or locomotives to be required for the removal of much if any of the excavation below the first water levels connected by locks, the highest one being the 130-foot level.

Fifth. By dredging under water little or no regard would need to be paid longer to the question whether the dredger encountered rock, gravel, or mud, science having provided our generation with machinery for dredging rock even cheaper under water than above it.[1]

The first Isthmian Canal Commission in its report of 1901 fixed the expense of extracting submerged rocks at about $4.75 a cubic yard. Mr. Bunau-Varilla directed the President's attention and that of his engineers to a modern process of rendering the rocks dredgeable at a very greatly reduced cost by the Löbnitz system, as it is called,[1] which was invented to meet the exigencies of the Suez Canal some eighteen or twenty years ago. By that system, now quite familiar to the Old World, though apparently unknown to the President's engineers, the rock work was done for the Suez Canal at the rate of fifty cents a cubic metre, or less than one tenth the price at which the engineers estimated the price by its familiar methods. The rock dredging on the Suez Canal cost fully twice what it would cost at Panama or would have cost in Egypt but for the interruptions of the work by the frequent passing of vessels and by the long distances to which the excavations had to be transported. Mr. Hunter, the Engineer in Chief of the Manchester Canal, is reported as announcing in 1905 before the President's Consulting Board of which he was a member, that several hundred thousand cubic yards of rock, harder than any encountered on the Isthmus, were going to be taken out of the Manchester Canal to give it a depth of twenty-nine feet by the Löbnitz method, and that the cost was rated a little less than fifty cents a cubic yard, which is the price of the excavation in the dry. This gentleman since then has published in the "Engineering" of the seventeenth of August, 1906, a note about the actual price of this mode of rendering rock dredgeable under water and removable by dredges. It was, after ten months' experience, eighteen cents a cubic yard. In June, 1907, before the Institution of Civil Engineers in London, Mr. Hunter declared that the average cost after completion of the works had been twelve cents per cubic yard for making the rock dredgeable. If we add ten cents for dredging and transporting, the price does not reach twenty-five cents per cubic yard, say one tenth of the price fixed by our Isthmian Commission in 1906, and one nineteenth of what it admitted in 1907 as the standard price.

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[1] See reports and discussion before the June Conference of 1907 Institution of Civil Engineers—London Transactions of Section II.

These low prices of rock dredging are confirmed by the results in many other large maritime works of the Old World, including those of the empire of Japan which has purchased seven of Löbnitz's rock-dredging plants from 1900 to 1905.

In the process of the investigation before the President's Consulting Board, Mr. Wallace, the first Engineer in Chief of the Panama Canal, testified as follows:

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[1] A system by which a column or shaft of steel with a movable point may be made to descend upon the hardest rock and crush it in pieces of the size of a man's hand, when it becomes entirely dredgeable.

"As to the excavation of rock under water there is *a process of which there has been no question in any of the reports,* but I think that Mr. Bunau-Varilla has referred to it. It is the process which consists in breaking rock by what they call the hammering system."

Mr. Hunter: "You mean the Löbnitz system?"

Mr. Wallace: *"I do not know how you call it."*

Mr. Hunter: "You need not dwell on that subject; we have discussed this in the Commission fully. It is a process with which both Mr. Quellennec and I are very familiar."

Mr. Quellennec was a member of the Consulting Board. He had been selected on account of the distinguished position he held as Consulting Engineer of the Suez Canal. It is a curious circumstance that Mr. Wallace, the first Chief Engineer of the Isthmian Canal, had never heard and did not know the name of the Löbnitz system, and still more remarkable that in the official report made by the Consulting Board there is no reference to the subject of the Löbnitz system, although Mr. Hunter, the chief engineer of the Manchester Canal, says: "We have discussed this subject at great length. Why it was excluded it is difficult to surmise, unless the resident engineers knew nothing about it, or the millions of money and the years of time saved by its use in the construction of the canal were not worth saving. By this process there would be no loss of time, as by the dry haul, where, during the rainy season, thousands of men may be left idle while a train or an engine is being extricated from the mud into which the railway track has been sunk or washed away. Nor would there be any corresponding expense for relaying the track every three or four feet that the trench is deepened. In fact, the dredge would almost completely supersede the services of the railway while the men would be protected from sun and rain."

An objective lesson of the advantage of this wet haul has quite recently occurred and was thus first reported in the "Canal Record" of October the ninth:

> "Owing to the heavy rainfalls of the past few weeks, the Cucaracha slide which remains quiet during the dry season has again begun to move. It remained practically quiescent during the entire period of control of the new French Company. With the resumption of work by the United States in 1905, the slide again began to move and has continued to give more or less trouble during

every wet season since. The total amount of material in movement is estimated at about 500,000 cubic yards. The movement during the present season has been more rapid than usual and the berms have been filled up, permitting a part of the material to get into the canal prism. Shovel No. 223 was caught by the moving mass of material on October 4th and was extricated unimpaired on October 6th. Shovel No. 109 was also caught, but was pulled out by wrecking train on October 5th."

In the succeeding "Record" of the sixteenth October we read:

"The work of removing the material cast into the Culebra cut by the Cucaracha slide has continued without interruption day and night since the last issue of the 'Canal Record,' and several hundred cubic yards of material have been taken out. To avoid delaying the movement of the dirt trains a track is being laid from the bottom of the cut up to the second level on the west side. This track will be completed in about a week, and when finished the movement of dirt trains will cease to be affected by the slide."

Here we have a slide of 500,000 cubic yards, part of which went into the prism of the canal, and the rest so occupied the track as to delay or obstruct the movement of dirt trains more or less for the succeeding two months at least. Two shovels were caught by the moving mass which it took two days' labor to extricate. A new railway track had to be laid which was to take two weeks to construct, and meantime we can only guess how many men are to be withdrawn from the canal work proper and for how long a time. By the "Canal Record" of November 6th we learn that the work in the Cucaracha slide "has been aided by the slow movement of the slide which has dropped from fourteen feet a day, the rate maintained during the first two weeks, to about four feet a day. Two tracks have been laid past the foot of the slide, and the third track (three tracks instead of one) will be laid in a few days. The movement of dirt trains to the full capacity existing before the slide will then be resumed."

In the same "Record" of November 6th we are told that the total excavation during October was 1,868,729 cubic yards. Of this grand total of excavation, it adds, 826,891 cubic yards were from Culebra, while the total by dredges was 766,754 cubic yards,—409,632 of these at Colon and 357,122 at La Boca. On accessory work outside the canal prism, 24,258 cubic yards were taken by dredges, by which it appears that 791,012 cubic yards, or more than half of the reported October output, were not taken from the Culebra division but from the low levels at the extremities.

During a period now of entirely six weeks at least, up to November 6th, all the force on the canal that could be made available for that purpose has been occupied in fighting the Cucaracha slide.

We are therefore bound to conclude that a very considerable proportion of the 826,891 cubic yards reported to have been taken from the Culebra cut was taken from the Cucaracha slide and not from the prism of the canal in the Culebra division. Had the attack upon this hill been made by a floating dredge, the slide would in no way have necessitated the interruption of the work for its removal for six weeks or probably two months, while building three railways, which would then have been apparently superfluous.

Nothing that indicates a disposition to exchange the dry for the wet haul has yet transpired in executive quarters.

On the contrary, in the report of Mr. Goethals of October, 1907 (Annual Report of the Isthmian Canal Commission, page 3), we read:

> "As the rock portion of the cut can be *removed* . . . more economically in the dry than in the wet—"

Does not this monumental error show the necessity of completing Colonel Goethals' instruction on this capital point? However valuable may be his services on the canal his time will be infinitely better employed if he is sent to Europe and to Japan to learn what he seems to ignore absolutely, the cheapness of rock extraction by dredging if properly handled, and that it is now *much cheaper* than to remove it in the dry.

As the difference between the wet haul and the dry haul means a difference of at least half in the expense and of more than half in the time required to open the canal for traffic, I will here insert some extracts from the Transactions of the English Institution of Civil Engineers, giving the substance of a recent conference of that body in relation to rock dredging with special reference to the present rock removal operations at Blyth. The substance of their deliberations are embodied in the following extracts from the statements of two of the conferees.

MR. W. H. HUNTER (the Engineer of the Manchester Ship Canal):

"In rock-breaking with rams under ordinary conditions it may be reckoned that about 115 blows could be delivered per hour paid for work. Mr. Quellennec adds that, as a matter of fact, he gets eighty-three blows, so that the difference between the eighty-three and the 115 represents the loss due to stoppages occasioned by passing traffic. We are working, especially in the daytime, under similar conditions; and perhaps it may be interesting if I give the exact figures for the last complete month for which the figures have been tabulated—that is, for the month of April. . . .

"We have at the present time broken with the rock-cutter just under 280,000 cubic yards of rock. Taken all round, the average cost of rock-breaking, which is the point we are really concerned with here, has been 5.9d. You will observe in Mr. Quellennec's figures that there are great differences, owing to the varying character of the rock, but these are actual figures got out by the accountants to the Canal Company. They are actual figures which are furnished to me month by month of the cost of the works which are in hand; and adding that 2d., if you like, it makes the average cost of these nearly 300,000 cubic yards of rock broken by the cutters something under 8d. These are plain matter-of-fact figures."

Mr. P. Bunau-Varilla: "The two very interesting and important notes that have been read in connection with submerged-rock dredging brings out a factor of the highest importance which cannot be emphasized too much. . . . Now we have arrived, thanks to the Löbnitz system, to a point where it can be said that, even against the hardest rocks, the dredging system has every advantage. I wish to point out that from now onward rocks under water can be excavated at a less price than in the open air. It must also be remembered that the last word has not been said with regard to the rock-dredging system, and that new improvements can be expected which will tend to still further lower the price at which the work can be done. The cost of the work, which, as the authors of the notes and the eminent chief engineer of the Manchester Ship Canal have shown, is to-day very low, is bound to be in the future still lower, for the very same reason that makes it now much cheaper than when the Löbnitz system was first introduced. . . .

"We have heard this morning Mr. Hunter stating that on the

Manchester Ship Canal the average cost of making 280,000 cubic yards of rock dredgeable had been 5.9d. We must note the very important circumstance that in three different parts of the earth, in the Suez Canal, at Blyth, and at Manchester, experimental prices are given of the cost of transforming rock into ordinary dredgeable ground ranging from 6d. to 10d. a cubic yard. These are indeed very low prices. You will further notice that in each of those three cases there are hard strata. Mr. Quellennec said that some of the strata are extremely hard; Mr. Sandeman tells us that there is a part of the rock treated at Blyth which can compare in hardness with basalt, and Mr. Hunter also pointed out that there is a very tough and hard rock met with at Manchester. Those three facts show that in the three cases the conditions range from hard to soft rock, and that the Löbnitz system is not to be stopped by any hard rock. . . .

"I wish, as a final remark, to state that however reduced are the prices now obtained, still lower ones are forthcoming; we have not arrived at the end of the development of the Löbnitz system, nor have we arrived at its full efficiency and the lowest price of its operations. We see from Mr. Quellennec's note that rams of three tons, four tons, or five tons could not pierce the hardest ground more than one foot eight inches, and that the cost was 7s. 3½d. With rams of thirteen tons the ground was made dredgeable to a depth of two feet seven and a half inches and the price was reduced to about 1s. Therefore a threefold increase of the ram has produced that extraordinary transformation in the cost and in the productivity of the Löbnitz system. Why should the ram be limited to fifteen tons? There is absolutely no reason whatever. We have seen an extraordinary development of the results by trebling the weight of the rams. I am perfectly sure that if we make another step of the same importance, if we go to rams of thirty tons or forty-five tons, we shall see these already very low prices, ranging from 6d. to 10d., brought down to something absolutely insignificant. For the very hard material in the Suez Canal, which, as Mr. Quellennec says, requires six times more blows than the average rock, the cost will be brought down to what is actually the average. I foresee, therefore, by the simple development of the method which is now passing through one of its progressive stages, the price being brought down to an insignificant amount of 2d. or 3d., and the hardest grounds made dredgeable for about 8d. to 12d. Even with fifteen-ton rams, it is very easy to see that there is no hardness of rock that can resist destruction by the Löbnitz system. When a fifteen-ton Löbnitz ram (thirteen tons in water) presses upon the ground in a statical condition, it exercises pressure which is five times the limit of resistance of the hardest rock (porphyry, two and one half tons per square centimetre), and when it falls from a height of ten feet the accumulated energy on the point, which is one centimetre surface, is just twenty-three times the average energy accumulated per square centimetre of the section of a shell going out of the most powerful gun existing."

VI

MR. BUNAU-VARILLA's suggestion was to provide the first of the locks at the 130-foot level with a bottom at ninety-five feet say, which was sixty-five feet below the average level at which the digging of the bottom of the Culebra cut was left by the French Company. The President, under or with the concurring assent of his engineers, recommended that they should defer providing a single lock until they should reach the eighty-five-foot level for the water and the forty-foot level for the bottom. This means a postponement of any use of the locks for any purpose until the Culebra cut for the whole seven miles had been deepened one hundred and seventy feet below its level as left by the French Company, and fifty-five feet lower than recommended by Mr. Bunau-Varilla. Even should it ever be contemplated to use the locks for the wet haul as proposed by Mr. Bunau-Varilla, this decision defers any use of the canal for transit purposes for the many years to be consumed in digging down the fifty-five feet to the eighty-five-foot level. The object of beginning the lock system at the earlier 130-foot level was not only to expedite the digging of it without waiting longer than was absolutely necessary, but also that the canal might the sooner become navigable and begin to earn its expenses, which would seem to have been perfectly practicable in four years, or by next May.

At present the public has no reliable evidence that the prism of the canal on the Culebra has been deepened a single foot through the whole seven-mile breadth of the Culebra hill, if even at any part of it. The excavations thus far have been mostly, if not entirely devoted to widening the trench already cut by the French Company.

In regard to the locks, Colonel Goethals as late as the eighteenth of August last reports: "In order to lay concrete in locks next year a plant must be contracted for this year, but appropriation not sufficient." He then asks permission to run in debt in excess of the appropriation,—$4,000,000 for labor and $4,000,000 for material, which means of course in part "the plant" for the locks. Thus it will not be until 1909, when at the present rate of monthly expenditure the entire estimated cost of the canal will have been expended, that the real construction of the locks can be expected to begin.

Colonel Goethals in asking permission to run the Secretary of War's face for $8,000,000 says: "This is required, not as an increase of cost of canal but in order *to work faster.*" This despatch will establish the Colonel's hitherto unsuspected reputation as a humorist.

The President promptly sanctioned his engineer's request "to continue expenditures in excess of pro rata monthly allowance *on account of present necessities and unforeseen developments.*"

It will be just like our Congress to be asking a lot of impertinent questions about what were these unforeseen developments. The only unforeseen development at present in evidence is the shameful fact that by the end of the fiscal year in June, six and a half tenths, say two thirds, of the estimated cost of the works ($78,000,000 out of $120,000,000) will have been spent and not one quarter of the work will have been done.

VII

Mr. Bunau-Varilla recommended to the President a lock canal at the 130-foot level of the Culebra as the most expeditious way by many years of providing a waterway available for commercial or military purposes, but with the understanding that the locks were a temporary provision, to be maintained only until the canal would be converted into a strait.

This plan of a temporary lock canal, contemplating its contemporaneous enlargement into a navigable Strait without interrupting the navigation of the lock canal, was pressed by Mr. Bunau-Varilla upon the attention of President Roosevelt's Consulting Board in September, 1905. He pressed it upon them and the President at that time, and again in 1906.

First. Because, as he explained, the work of the enlargement could go on without interfering in the least with the operation of the lock canal or with its traffic;
Second. Because of the extraordinary and unexpected reduction of the cost of excavation by the employ of natural or gratuitous water power;
Third. Because of the earlier opening of the canal for traffic by beginning the wet haul at the 130-foot level, which he counted upon achieving in four years;
Fourth. Because of the reduced cost of disposing of the *deblais;*
Fifth. Because of the seismic disturbances to which the Isthmus is subject and which by a seam in a single lock or dam might interrupt further traffic on the canal for an indefinite period if not forever. Hence the necessity of making the period of our dependence upon locks as brief as possible;
And, finally,
Sixth. To provide for the inevitable exigencies of commerce for which the lock canal as recommended by the President and now in course of construction will in a very short time prove totally inadequate.

Assuming as true, what authentic statistics already teach us, that there are now ready to take advantage of the canal six millions of tons of freight, what shall become of the tonnage that will be waiting when the American population between the Pacific and the Rocky Mountains, now amounting to only about four millions, shall reach forty millions? What shall become of the traffic when the population of the extreme East, a third of the human race, wakes up from its long sleep? What will become of the traffic when close commercial communications shall be established with the Atlantic coast of America, so rich, productive, and industrious?

Consider the traffic of the Saulte Sainte Marie through which in 1869, less than forty years ago, there passed a little more than half a million of tons. In 1903, barely thirty years later, thirty-five millions of tons were carried, and this, subject to an interruption of the navigation by ice for a third of the year. The traffic for 1905 exceeded forty-four millions of tons. Vessels of war are already building, not only in Europe, but what is more serious, in Japan, which could never be locked through the Isthmian lock canal as now under construction.

So recently as the first of November the following statement appeared in the editorial columns of the "New York Tribune":

> Entirely apart from future developments, therefore, the present demand is for a canal which will give commodious passage to ships of 88 feet beam and 785 feet length. We may well doubt whether the locks as originally planned would do that. A width of 100 feet would leave only six feet at each side of the *Mauretania* or of one of the new battleships which this country is about to build. Theoretically, on the principle that "a miss is as good as a mile" that might be enough. Indeed, a ship 99 feet wide would be quite safe in a lock 100 feet wide, provided she could be kept perfectly true in the centre. But in raising and lowering the ships in the locks it would in practice be exceedingly difficult—without taking entirely too much time in the process—to avoid some oscillation, and the results of even a slight impact of a 25,000-ton steel ship against the walls of a concrete lock are not to be contemplated without much apprehension. The additional ten feet now decided upon will increase the space at each side of the ship to eleven feet. That may be enough, but we doubt if many prudent engineers will consider it an excessive, if even an ample, margin of safety.

VIII

FOR reasons already cited and others which may become before long of even greater importance, Mr. Bunau-Varilla two years ago urged upon the President as a manifest duty to dismiss from his mind the idea of regarding the lock canal as a perpetuity, but to have it constructed with distinct reference to its contemporaneous enlargement to a waterway *forty-five feet depth at the lowest tides* and *six hundred feet breadth at the surface of the water,* so that the largest ships likely ever to be built may navigate it easily, safely, and as early as possible, and of course dispensing with all locks as speedily as possible,—even with tide locks which would be necessary for a narrow sea-level canal and are no more necessary with the straits which Mr. Bunau-Varilla advised.

It is reasonably certain that the permanent lock level canal now in course of construction, if prosecuted by the present tardy and wasteful processes, will require very nearly if not quite an equal number of years *to begin to earn anything* that the strait would require, and that it will cost more than the strait, and when built will be quite unable to accommodate the steamers of the standard dimensions for ocean navigation at that time, if not of vessels the keels of which are already laid.

A temporary lock canal is indispensable to provide the water necessary:

First. To furnish the light, heat, and power necessary for the whole canal zone;
Second. To float the dredges, the scows, and the tugs;
Third. To dispense with the daily increasing costliness of the whole railway system of excavation at the Culebra;
Fourth. To speed the time by eight years at least, when the canal would become available for traffic.

In his exposition of this subject before the Consulting Board Mr. Bunau-Varilla insisted that the sea-level canal with tidal locks recommended by the majority of the Consulting Board would consume as much money and time as the Strait of Panama would consume by the methods he had proposed for providing water power and its employ in excavation, if adopted. He gives the figures as computed by the Isthmian Commission for the sea-level canal at $300,000,000 and in this allows twenty per cent. for margin and oversights.

In regard to the strait, Mr. Bunau-Varilla estimates the number of cubic yards of excavation at 600,000,000, of which sixteen large electric dredges attacking the central prism would take out 30,000,000 cubic yards a year, or the whole 600,000,000 in twenty years. "This estimate"—as to the time allowed to build the strait—twenty years—during the operation of the lock canal—he says, "is like all that I presented to the Board, the *maximum maximorum* of time and cost. The central prism embraces less than half of the total cube, requiring but 260,000,000 cubic yards of excavation. The other parts of the canal to be enlarged for the strait should be dredged simultaneously with the Culebra, in which case the enlargement and deepening of the lock canal into a strait would require but about ten years."

This prophecy invites here a reference to the official reports of the excavation referred to.

For the three months, January, February, and March succeeding the President's visit to the Isthmus, the monthly output from the Culebra cut averaged 673,000 cubic yards. For April the cube was reported at 879,500. So far it seemed to realize the prediction of the President in December, 1906, when, after referring to the 323,000 cubic yards taken out in September, 1906, he proclaimed that the cubes of excavation were destined to increase in enormous proportions. The next month of May the output fell to 690,363 cubic yards. The War Department had promised that it should pass the million figure. The cube for June fell still lower, to 624,588 cubic yards. For some reason only known presumably in the War Department, this output instead of being announced as early as usual at the beginning of the following month, was not published until the end of July, and was colored by reports through the "Morning Post" of London of friction between the War Department and Colonel Goethals, reported to be much discouraged and anxious to be relieved from further duty on the Isthmus. It is with reluctance that I here report an impression entertained in quarters likely to be informed, that the friction here referred to was that the Chief Engineer at Panama and the War or the Executive Department were not agreed about the ethics of increasing the output by dredging in the prism of the canal, where no place for depositing the excavation had been prepared.

The following month we read of the long-promised million cubic yards of output at last obtained. This time the news did not have to wait till the end of August to be spread over the country that 1,058,776 cubic yards had been excavated the previous month—but accompanied by no intimation that of this output 212,710 cubic yards were taken, not from the Culebra cut but from the canal prism at Colon and at Panama, where the dredging is most easy and subjected to no delay for transportation. So, the dredging in the Culebra cut for July, instead of yielding over a million, was only 770,570 cubic yards. As all the output of the dredges is absolutely required for the dams to be built, why are the dredges doing work that is not pressing and with no place ready to utilize its output?

The August report from Colonel Goethals to the President claims an excavation by steam shovels and dredges of 1,274,404 cubic yards. "This exceeds all previous records," says the Colonel. The President sends him a letter of congratulation for what he terms his "extraordinary showing during the month of August." Unhappily for the credit of both parties, neither alludes to the fact that 358,454 of these cubic yards were not from the Culebra hill at all, but were dug by the Colon dredges and by the Panama dredges,—the dredging of both which ought to have been deferred till the places for which the dredgings were required were prepared to receive them, and the whole force and money expended upon the point of most resistance. Thus the August Culebra output falls back to 786,866.

It is not altogether a strange coincidence therefore that it is in this same month of August that Colonel Goethals telegraphs the President that all the appropriation for the canal provided by Congress for the canal work up to March, 1908, had been expended, and urges him to sanction his "running his face" till Congress meets to confirm such proceeding, that it may not be necessary to reduce the force for want of money. It would be painful, of course, but not surprising if Congress should ask Colonel Goethals to explain at whose behest he operated his dredges in the low Panama and Colon valleys so prematurely, and apparently with no other object than to make a factitious exhibition of the least pressing work to the prejudice of the most pressing. Colonel Goethals has officially recognized that the Culebra cut and the Gatun dam are the great obstacles with which he has to contend, and that the rest of the work would be finished long before these were ready, without taking a single man or machine from those two most immediately important and pressing fields of labor. It will be hard to persuade any person who knows Colonel Goethals that either he or indeed any officer of his rank in the American army would have diverted his men and machines from the work where they are most required merely for such an ignominious purpose as to impose upon Congress or the public.

It would not be very surprising if the real explanation of what our peripatetic Secretary of War authorizes us to call the "cowardice" epidemic, which bereaved his canal department of three chiefs in two years, may have been reluctance to cook the reports of their work to suit the political exigencies of the Administration.

A few words now about the Gatun dam recommended by the President and adopted by the Commission.

This dam was denounced as unsafe, dangerous, and indefensible on scientific grounds by Mr. Bunau-Varilla; it was admitted by the President after visiting it, to be "risky," and his Chief Engineer, who has not yet even begun its construction, says now that the time necessary for the completion of the canal depends, not upon cutting its way through the Culebra hill, but on the construction of this Gatun dam. In this he is doubtless correct. This dam is simply a preposterous piece of work, and should it be prosecuted according to the proposed dimensions, is liable not only to result disastrously to the canal itself and to the whole country below that will be at its mercy, but also to seriously delay the use of the canal.

It is to be erected across the bed of the Chagres River, and to be 7700 feet or a mile and a half long. The water to be supported by the dam will be from eighty-two to eighty-six feet in depth, and 105 feet above the bed of the Chagres. The time for its construction as estimated by the minority of the Board is nine years, but by the majority of the Board fifteen years. The total filling necessary is 20,000,000 cubic yards.

By an almost inconceivable lack of forecast the dams and the locks of the President's plan, both on the Atlantic and Pacific sides, are so located as to be easily bombarded from the high seas.

This is the kind of dam which is to displace the dam at Gamboa proposed by Mr. Bunau-Varilla, which could be built according to his estimate in less than one quarter of the time, at far less than one quarter of the expense, and which would be of dimensions and of mode of construction, as well as of foundations, which no engineer or President would ever speak of as "risky." It is not surprising that Colonel Goethals speaks of the Gatun dam as threatening more delay in its construction than the piercing of the Culebra. His delay in beginning this dam warrants at least the suspicion that he hopes Congress will relieve him from the necessity of prosecuting a work which is so certain to prove fatal to the reputation of the engineer whose name is associated with it.

The strange, not to say obstinate, silence of the Isthmian Commission in regard to methods of construction of the Panama Canal which are commended to them by every consideration of economy, whether of time or expense, as well as by the counsel of one of the most accomplished civil engineers of the age, who has the peculiar advantage of knowing by experience more about the natural obstacles as well as the natural facilities for building the canal than any man living or dead ever knew, seems inexplicable upon any theory which engineers fit to be employed on such a work should be willing to avow.

And how much longer is this scandalously wasteful policy to be tolerated? Shall this Isthmian Commission be permitted to pour the gold of our country as the maiden daughters of Danaus were condemned in Hades to pour water, into a bottomless vessel, eternally?

IX

Since writing the above, Mr. Goethals, the Chief Engineer of the canal has repaired to Washington and, under date of December 9, reported to the Secretary of War that the place which the President with the aid of his Consulting Engineers has selected for the construction of three earth dams on the Pacific side were utterly impracticable; and he recommends another site for dam and locks —one lock at Pedro Miguel and two at Miraflores—that is, at the very site recommended since 1887 by Mr. Bunau-Varilla. "It has the advantage over the present project," says Mr. Goethals, "in that the dams of lower height, less length, and resting on rock comparatively near the surface, can be more easily constructed and completed at an earlier date. It is to be preferred by reason of the fact that the location of the locks secures them against all possibility of distant bombardment and affords them greater security against gunboat or torpedo-boat attack."

Obviously the technical, not the military, are the only serious reasons. For surely neither the President nor his military advisors would require two years of reflection to assure themselves that a lock five miles inland is better protected from high seas bombardment than one at the seashore.

Now it so happens that there is not a single one of the advantages of the proposed change of locks and dams that was not just as obvious the day the canal work was visited by Mr. Taft and his Consulting Engineers in April last, nor one that does not apply to the Gatun dam with infinitely greater force; nor one which the location recommended by Mr. Bunau-Varilla for dams on either side of the backbone of the Isthmus would not have avoided.

Notwithstanding Colonel Goethals' recommendation, which the President has approved of, for the abandonment of the Gatun dam, the Secretary of War a few days later—on the 16th instant—informs the Senate Committee on Interoceanic Canals that "it has been decided not to finish the Culebra cut *until the work on the Gatun dam and locks is completed.* Is the War Office myopic that it can see only the Pacific side of the canal but is blind to the Atlantic, or, to use a famous aphorism of Pascal, "True on one side of the Pyrenees, false on the other"?

On the same occasion the Secretary indulged himself with the cheerful prophecy that "the total cost of the canal work" in his opinion "would not exceed $250,000,000, which is only 100,000,000 more than the original estimate of his engineers. The Secretary and his Engineer seem to be yet more discordant as prophets than in their knowledge of the work at the Isthmus, if we may trust the following announcement in the "Sun" of the 19th instant.

CANAL MAY COST $500,000,000

Goethals Says No One Can Tell What the Outlay at Panama Will Be

WASHINGTON, Jan. 9—That the Panama Canal may cost the Government $500,000,000 was the statement of Col. George W. Goethals, chairman of the Isthmian Canal Commission, at a hearing before the Senate Committee on Interoceanic Canals to-day. The admission was brought out in response to questions from the chairman of the committee, Senator Kittredge of South Dakota. Chairman Goethals had said previously that any estimate as to the cost of the canal was guesswork.

"Are you prepared to say that the canal will not cost more than $250,000,000?" inquired Senator Kittredge.

"No, I am not," was the reply. "I believe it will cost all of that."

"Are you prepared to say that it will not cost over $300,000,000?"

"No, as I said before, it is impossible at this time to say just what the cost will be," was the reply of the chairman.

"Would you be willing to say that the cost will not be above $500,000,000?" persisted Senator Kittredge.

"As I said before, it is impossible to say at this time," replied Chairman Goethals. "It might even be $500,000,000."

The "Record" of the eighteenth of December does not give the usual report of the work done in the Culebra cut for reasons which the reader is permitted to conjecture, but we are told that *"good progress was made in the removal of material carried into the* *canal prism by the Cucaracha slide.*" This slide announced its arrival on the fourth of October last by depositing about 500,000 cubic yards of earth upon the railway track and an unknown quantity into the prism of the canal, carrying two steam shovels with them. Three months and a half have already been spent in getting rid of this slide, and on the eighteenth of December the "Record" is hopeful that "within a comparatively short time the slide *will cease to be an inconvenience to the work.*" This statement leaves the reader in doubt whether the Culebra cut is an inch deeper to-day than it was on the fourth day of last October, while the output of the dredges in the lowlands at La Boca and Colon which should have been deferred until the Culebra was cut deeper, boasts of an output in November of 782,720 cubic yards.

Though I have not a word to say in defense of the necessities for or the processes by which so many changes in the consulting and directing engineers whose advice about the construction of the canal has been taken or rejected, I think that the country is to be congratulated upon the fact that an army engineer has been finally selected for the prosecution of this great work, who, as far as the law permits, gives evidence of both the ability and a disposition to prosecute it with a single eye to its speediest and most economical consummation which the law permits. None of the scandalous blunders in the plans or the reckless waste of money which has resulted can be justly laid to Mr. Goethals. His abandonment of one of the two preposterous dams which he was expected to build furnishes the best possible augury that at last the canal work has drifted into the hands of a person who brings a competent professional judgment to his task. It allows us to indulge the hope that after the suppression of the Sosa dam he will make another and equally successful effort to rid us of the Gatun dam. To prosecute on the Atlantic side of the Isthmus something ten times more foolish than what has already been acknowledged and rejected as foolish would surely warrant a writ de lunatico inquirendo to issue to the responsible party.

If now Congress will give Mr. Goethals a free hand, the presumption is that he will next propose, if he has not already done it:

First. Locks at both sides of the Culebra cut, whatever may be its actual level to-day, a series of locks to join with the seas the canal as it is actually opened through the Culebra cut; these locks to be made temporary and economically to pass our battleships and yet more bulky commercial marine monsters while the lock canal is being converted into a strait.

Second. That he will treat the Chagres River as the greatest benefactor and ally of the canal, instead of what it has been hitherto esteemed, its greatest terror and obstruction; will treat it as the beneficent power which is both competent and willing to do all the work of digging the canal except what would devolve upon a comparatively limited number of experts; to supply light by night and by day to prosecute it when necessary, pure and wholesome water in abundance for the whole zone, and a reduction of the payroll from 40,000 men to not exceeding 15,000.

Third. Provide the Bunau-Varilla electrical dredges and Löbnitz rockcutters as fast as required to dredge the prism of the canal by which the rock work can be made as dredgeable as clay and at smaller expense than blasting rock work on land, and by which the dredgings will be disposed of without any railway tracks, trainmen, or any of the obstructions, waste of time and labor that they imply.

Fourth. Finally, ask Congress to carry out the President's effort, ineffectually made two years ago, to transfer the management of the Isthmian Canal from the Secretary of War to the Secretary of State where it properly belongs, and thus relieve both the President and his Secretary of War from duties which in addition to their other cares have proved so much too much for both.

APPENDIX A

WASHINGTON, 26th of September, 1905

Translation from the French.

HIS EXCELLENCY THEODORE ROOSEVELT,
President of the United States,
Washington, D. C.

Mr. President:

I have the honor of remitting to you inclosed the text of the projects which I have submitted to the International Consulting Board on the Panama Canal.

It contains, outside of the mathematical justification of the conception which I had the honor of presenting to you in March last, a new and important chapter on the final development of the method which I propose.

This development insures, by considerations based on technical principles of the strongest and most practical nature, an extraordinary and unexpected reduction of the prices of excavation and at the same time a not less extraordinary, a not less unexpected rapidity of execution, so soon as the first stage will be passed; so soon as the lock canal will be opened with a summit level at one hundred and thirty feet above the oceans, a thing which, as I have demonstrated, is obtainable within four years.

This reduction of the unit prices of excavation, this increase of the efficiency of the works, results from the employment of the natural forces of the Isthmus, thanks to its waterfalls, thanks to the rational utilization of the conditions created by a navigable waterway through the Cordilleras, thanks to the infinitesimal price of transportation of the spoils that will follow the establishment of this waterway. It results also from the creation of an interior sea by the erection of a large dam at Gamboa, which interior sea will receive all the spoils brought on water to it.

If the new method allows the opening to transit in a space of time of which nobody dared to speak, which without it would be chimerical, it also allows to contemplate for the final form of the canal an amplitude of which nobody dared to speak, which without it would be chimerical also.

It is possible with the new factors of price and of time to contemplate not only the establishment of a mere canal at Panama but of a real strait; not only the establishment of a waterway with thirty-five feet depth and two hundred and twenty feet width at the water level; of a waterway closed at its extremity on the Pacific by tidal locks, but the establishment of a waterway of such grandeur that it becomes comparable to those created by nature; of a waterway with forty-five feet depth at the lowest stages of the tide and six hundred feet width at the surface of the water; of a waterway where the greatest ships will be enabled to navigate with freedom without having anything to fear, thanks to this liberty of action from the currents produced by the tides freely admitted in the Straits of Panama, currents the maximum of which on the other hand never will be able to reach three knots and one third.

The opening of the Straits of Panama which necessitates the excavation of six hundred million cubic yards may be easily dug in a maximum space of time of twenty-five years and for a maximum expenditure of three hundred million dollars. In this estimation of time is included the first phase, that of opening a lock canal with a summit level at one hundred and thirty feet when the excavation of a sea level canal with tidal locks, with restricted depth and width, cannot become a reality within this time and for this sum but under great risk, if one employs as it has been exclusively thought up to this day the ordinary methods of work hitherto adopted (excavation in the dry) though such a canal requires but one third of the excavation necessary for the creation of the Strait. . . .

If I have discovered an unknown way through this mysterious labyrinth, if I have reached by a final step the solution of the "Secret of the Isthmus" which holds in suspense humanity since centuries, I owe it to the profound faith which I have in the advantages that will result from it for man; I owe it to the hope, alas, unfulfilled! that my country would find in the work of one of her sons a compensation to the sorrows which this great and generous enterprise has caused her.

It has pleased Destiny to render useless my efforts in that sense, but in its unfathomed wisdom it allows me to believe that these efforts will not be lost for France because they will be useful to America, and that in the grand procreation of the Bosphorus of Panama the two sister republics will rejuvenate their pact of eternal amity while thinking they have served in common this progress, always made of the efforts of the dangers and of the sorrows of man.

In offering to the United States, impersonated in her most eminent son and in the elected chief of her generous race, the benefit of solutions which represent in money more than six hundred million dollars' saving on the works, and the benefit singularly greater still, perhaps, which will result from the immediate delivery of the canal to the activity of its citizens, I am proud of having justified the confidence and the friendship of which you gave me, Mr. President, so touching and so precious testimonies.

I have the honor, Mr. President, of presenting to you my very deep and very respectful devotion.

P. Bunau-Varilla.

APPENDIX B

Paris, October 29, 1906.

Translation.

His Excellency Theodore Roosevelt,
President of the United States,
Washington.

Mr. President:

I have tried by all means to throw the light of my experience on the way to be followed, and on the fifth of March last I wrote to you, Mr. President, in an open letter:

"I do not hesitate to state that the excavation in the dry, which is necessary (in the plans you have adopted) to reach a level of navigation at eighty-five feet through the central mass, will retard the opening of the canal much more than it is expected; that this question is the only one which presents a real gravity (keeping the date of opening announced), and that, therefore, a higher passage at one hundred and thirty feet is recommended by all considerations of logic and experience."

Here are the grave facts that you are going to verify during your visit, Mr. President:

The discovery of its real causes may save the Panama Canal from most serious dangers. *It may preserve the United States from very cruel dangers, also, to which they are exposed through the prolongated absence of a communication between the oceans in case of war.*

I am trying once more to make the truth conspicuous in order to allow you to grasp it, Mr. President, during your next inspection of the works.

Does the cause of the defeat reside in an insufficient period of preparation or in too great economies?

Evidently no, because more than two years and a half have elapsed since the United States are in possession of the canal and they will have spent at the end of October the considerable sum of thirty-six million dollars.

The expenses at that date surpass by three million dollars the sum of thirty-three million dollars at which were estimated by the United States and paid by them all the works done by the two

Companies of Panama, all the houses, hospitals, storehouses they built, all the installations, and all the plant.

The Isthmian Canal Commission in their reports of sixteenth of November, 1901, and fifth of February, 1906, have stated that the old Panama Company had excavated seventy-two million cubic yards. To this figure must be added seven million cubic yards excavated by the new company.

If you think that the cube excavated at the end of September last by the United States amounts to about three million cubic yards, you will see that to make an excavation slightly superior to three million cubic yards, the United States have already spent a sum substantially superior to what they paid according to their own estimation for an excavation which is compared to theirs in the proportion of one hundred to four.

If one thinks on the other hand of the accusation of disorder and extravagance with which the works of the old Panama Company have been loaded, one cannot help reaching the conclusion that the actual results demonstrate their inanity and revolting injustice.

It is the error of the experts which is the cause of the defeat which the world witnesses to-day.

One has been led to accuse first the soldiers then the officers of the army engaged in this war against Nature.

"Labor is inadequate, we must appeal to the Chinese!" Here was the share of the soldiers.

"The Engineers on the Isthmus are incapable, we must call for the contractors." Here was the share of the officers.

The fault, Mr. President, is not with those who are fighting the battle, it is in the strategy which has been forced upon them.

The actual labor would be superabundant in quantity, no need of Chinese would exist, if the efforts of the workmen were not directed against the natural forces.

The secret of any struggle with Nature consists in associating to your aid the natural forces and not in fighting them.

I have tried before the Consulting Board to make prevail this essential notion that the basic obstacle on the Isthmus was rain under its torrid climate. To execute the works of excavation, of transportation, and of dumping in the dry on rails, it is to be willing to fight against Nature; it is to exact from tens of thousands of men an unfruitful and sterile effort.

To execute the works of excavation by floating dredges and to transport the spoils by water and discharge them into a deep artificial lake made in the center of the Isthmus, is to utilize natural forces and not blindly fight them. . . .

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[1] The figures given for the cube made by the United States differed slightly in the original letter. It was the cube then known by press reports. It has been deemed justified to substitute to these the final figures resulting from official records published since.

By adopting the system of working in the dry, both for digging out the level canal and for digging out the canal with locks with a passage at eighty-five feet above the sea, the Consulting Board committed the gravest of technical heresies.

You see, Mr. President, now the palpable consequences of this error. Under immense difficulties thousands of men fighting against Nature have not been able to do substantially more than three hundred thousand cubic yards, either in July, August, or September.

If, as I proposed, the work of excavation, transport, and dumping by water were installed, three thousand men would easily excavate one hundred thousand cubic yards a day in the Culebra cut. They would do this immense work protected from sun and rain in all seasons. There would then be no need of employing blacks, as white men could work perfectly well under these conditions. . . .

The digging out in the dry of the fifty-three million cubic yards of the Culebra cut is the huge error of the minority of the Consulting Board. The present results show a difficulty which will only increase on getting lower, for the cut will fill still more with rainwater as it gets deeper.

The dredging machine will therefore have to be applied to the excavation. But as the dredging system demands important preparatory works—the execution of a dam at Gamboa and the construction of locks for raising the barges into the lake—while this work is in progress the excavation in the dry may be continued on the highest point of the Culebra.

With an excavation of twelve million cubic yards, a canal can be opened at the elevation of 130 feet, giving passage to an iron-clad. This result may be obtained in four years, even with a monthly excavation of two hundred and fifty thousand cubic yards—an amount of work on which one may rely.

The execution of the locks which are necessary for passage at this level can also be completed within four years.

From that date on, excavations will be continued on the enormous scale that the dredging will permit of, without troubling universal transit.

To this method, which is so simple, the Consulting Board only raised one objection, namely, the imaginary price that it fixed in the most arbitrary way for the cost of the work of breaking the rock in order to render it dredgeable.

Send emissaries to Manchester, Mr. President, or to Liverpool, to Suez, Yokohama, Okasaki, Brest, or to Dakar, and they will see that the rock is crushed and rendered dredgeable at an inconceivably low figure, no matter how hard it may be.

The price of four dollars, seventy-five cents ($4.75), fixed by the first Isthmian Canal Commission for the extraction of the rock under water, and the price of two dollars, fifty cents, fixed by the Consulting Board, are both equally erroneous and misleading.

It is this latter price which was opposed to my proposal. The "Engineering" of August 17, 1906, contains a document given by Mr. Hunter, Chief Engineer of the Manchester Canal, establishing the fact that the average cost, during ten months' work, was less than eighteen cents (ninepence) per cubic yard for the breaking of the rock in the Manchester Canal in order to make it dredgeable. By adding the price of seven and a half cents—which is the official cost at Panama and Colon—for the dredging, transporting, and dumping in deep water, we get about twenty-five cents for the exact price of extraction of rocks harder than the average rock of Culebra.

It is ten times less than the price approved by the Consulting Board (two dollars, fifty), and nearly twenty times less than that approved in 1901 by the first Isthmian Canal Commission ($4.75), moreover the price of twenty-five cents is itself much too high for soft rock of Culebra, as the works at Yokohama and at Okasaki demonstrate more than sufficiently.

A revision should be made, based, not upon preconceived ideas, but on the practical reality of modern methods of execution.

This revision will bring about the suppression of the absurd dam at Gatun, which Godin de Lépinay only proposed in 1879 provided that it was recognized as feasible for his project of a canal lake. . . .

Besides this, the canal as it is now being constructed, seems to be making as difficult as possible the transformation into a strait, which would be so easy if the construction were undertaken with a view to this, as I explained to the Consulting Board.

The minority of the Consulting Board caused the Godin de Lépinay plan to be accepted as the eternal form of the Panama Canal. They appear to have been inspired with the desire to raise an obstacle to any possible transformation. But such a transformation is inevitable. The statistics of the Sault Sainte Marie Canal prove it.

The Senate only voted for the canal on the formal promise of Senator Knox that it would be transformed into this wide, free, sea-level waterway which I have called the Straits of Panama. But the honorable Senator made a mistake, however, in saying that America had half a century before her.

She has only about twenty years before her after the opening, and the transformation must by then, not be merely commenced, but quite finished. Preparation must therefore be made from to-day.

All these serious facts are worthy of the consideration, Mr. President, for which I now respectfully ask.

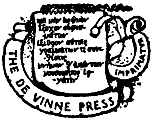
The date of the opening of the canal will be that of the effective protection of the Pacific Coast. Until then it is without any defense, at the mercy of the enemy.

Wrong ideas and bad advice may uselessly delay this date from six to seven, and perhaps even to ten years, and may compromise, both now and later on, the great work that America has undertaken and may perhaps threaten her security in case of foreign war.

The man who declares most plainly the Truth is the one who gives the most substantial proof of his friendship.

It is under the shield of this idea, Mr. President, that I place the expression of the opinions contained in this letter, which I close with the assurance of my most respectful sentiments.

P. Bunau-Varilla.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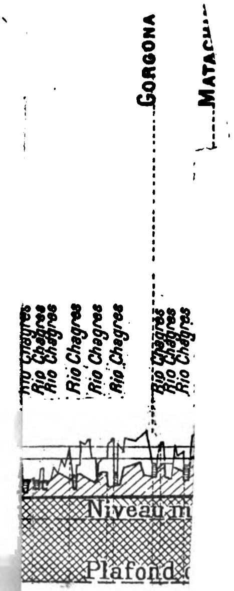
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